COCS2626 Cloud computing 2021 - Assignment 2
RMIT University

Victoria Road Accident Analytics

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Jakrapun Sangchan (s3808216)

Contribution Agreement

RMIT UNIVERSITY

RMIT Classification: Trusted

Appendix: Student Contribution Agreement

Victoria Road Accident Analytics

Student Name: Jakrapun Samgchan	Student Name: Nithit Rakkijsiri
Student ID: s3808216	Student ID: s376900
Contributions: 1. QuickSight dashboard design 2. Create athena table 3. Handle IAM policy for QuickSight	Contributions: 1. Create Lambda function and API Gateway 2. Connect google map API 3. Deploy webApp and API to Elastic Beanstalk
Contribution Percentage: 50	Contribution Percentage: 50
By signing below, I certify all information is true and correct to the best of my knowledge. Signature: Jakrapun Samgchan Date: 30/01/2021	*By signing below, I certify all information is true and correct to the best of my knowledge.* Signature: Date: 30/01/2021

Links

https://www.cloud-project-js-nr.com/

Summary

This project focuses on analysing the road accident data across Victoria and create a user-friendly interface to understand the analysis result. We use a public dataset from Vicroads data that record road accidents across Victoria from July 2013 to March 2019. We decided to use AWS quick sight to get insight from the data and create an online dashboard. Google map API has been used to illustrate the location and detail of accidents.

Introduction

Motivation

The motivation of this project is to create a simplified dashboard about characteristics of road accidents in Victoria to help stakeholders understand which factor contributes to the accident.

How does it work?

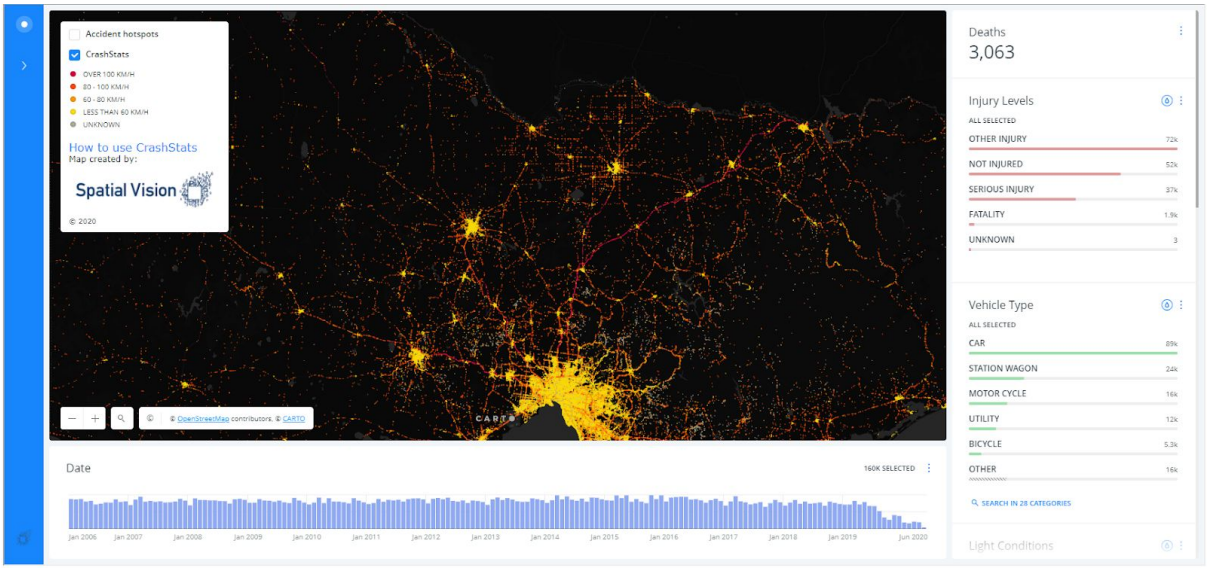
Our Analytics app has three parts.
The first feature is an **analytic dashboard** that shows summary statistics of road accidents between Jul 2013 and March 2019. The dashboard shows simplified charts and a short summary of each chart. The Dashboard section has a print feature that users can export the dashboard as a PDF file.
The second part **maps**, which shows the location of recorded accidents on the map according to user filter preference.
The third part is the **export data**, this feature lets the user can export the full dataset of this analytics.

How can it be used as a real-life application?

This project demonstrates how to create data analytics on cloud environments. This project would like to simplify cloud data analytics web application. So, people could use this project framework to implement another data analytics web application.

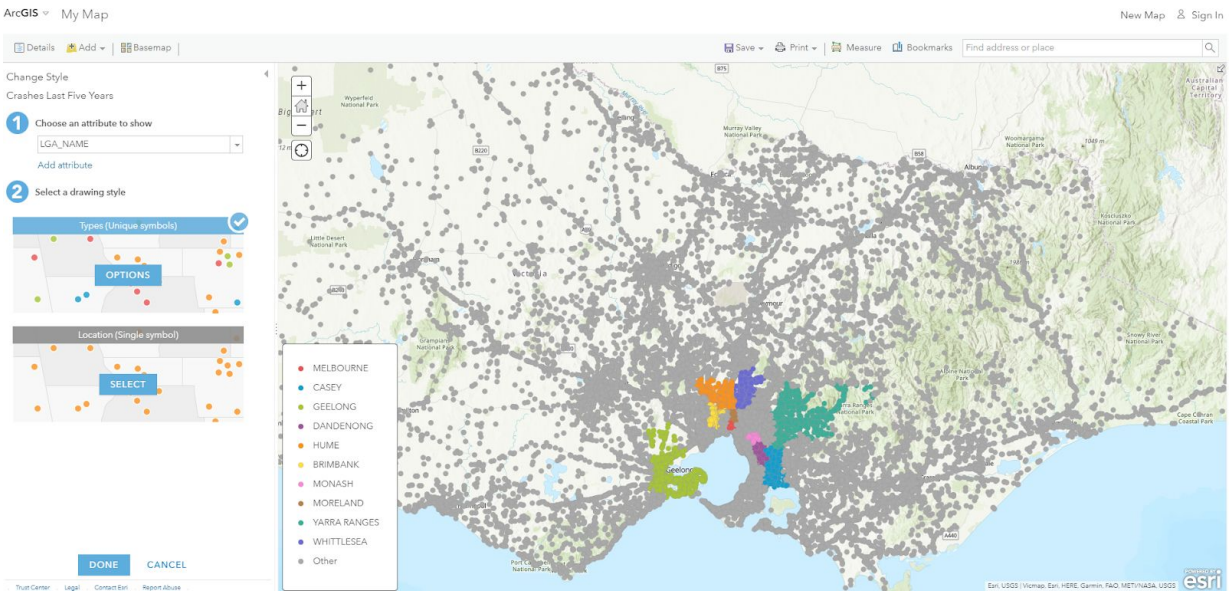
Related work

There are many works that are related to this project. The visualization below is one of the examples of road accident analytics from Spatial Vision company. The visualization shows statistical information about road accidents. [2]



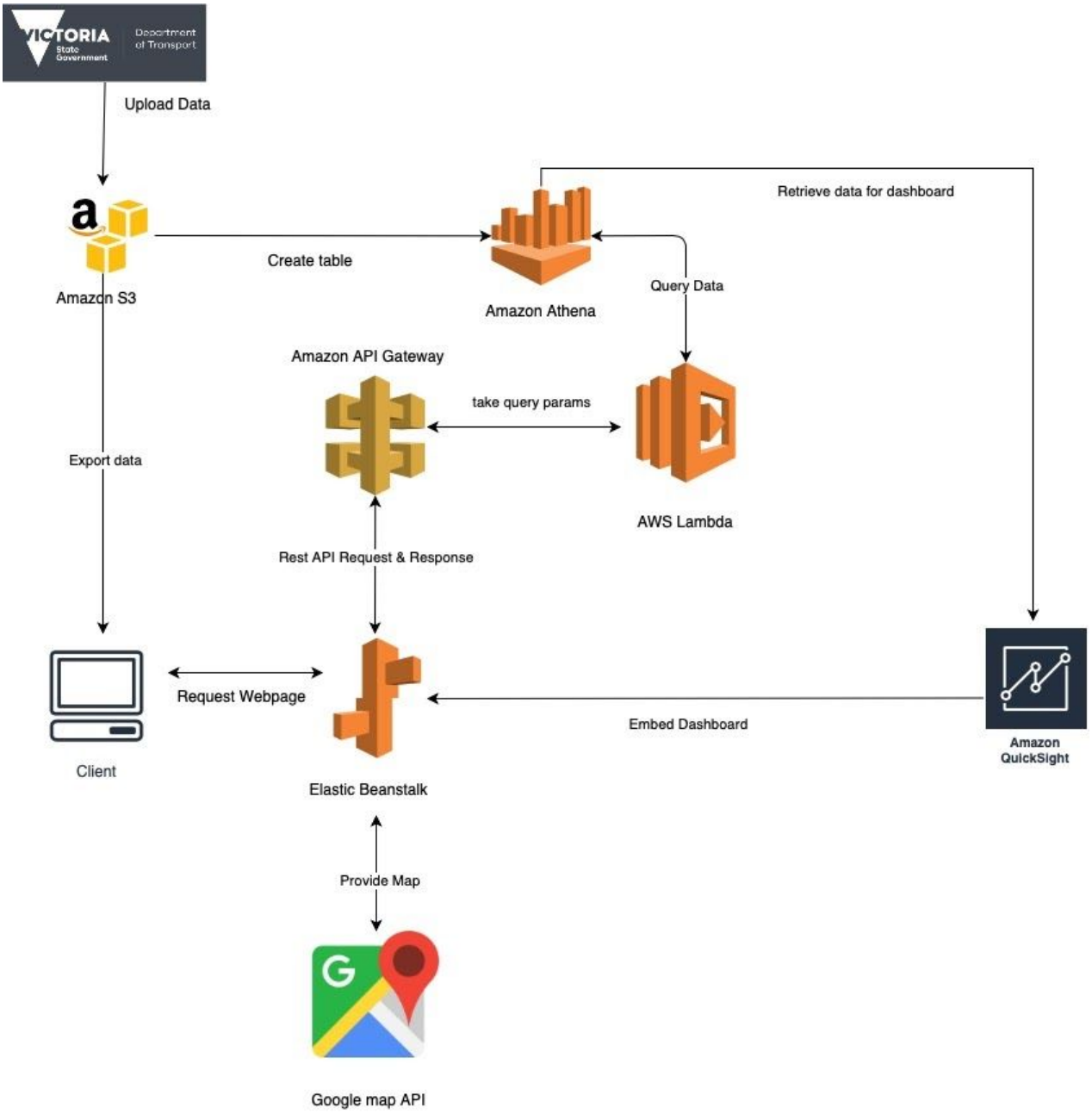
https://www.spatialvision.com.au/crashstats/

Other related work is on Vicroads website. The visualization shows the location of an accident with one attribute such as LGA_NAME. [1]



https://www.arcgis.com/home/webmap/viewer.html?panel=gallery&suggestField=true&url=https%3A%2F%2Fservices2.arcgis.com%2F18ajPSI0b3ppsmMt%2Farcgis%2Frest%2Fservices%2FCrashes_Last_Five_Years%2FFeatureServer%2F0

Software Design/Architecture



A high-level architecture diagram

- Services and framework
    - Services
        - Elastic Beanstalk
            - We use elastic beanstalk to host the web server with Node.js 12 running on 64bit Amazon Linux 2/5.2.4. Because of using embedded dashboard from Aws Quicksight require valid certificates for the web server, so

additional configuration is required eg. add listener port (443) for https and public domain is used.

- Aws API Gateway
  - We use Rest API protocol to handle all requests from our web server.
- Aws Lambda
  - We use Lambda proxy integration with Aws API Gateway.The Lambda function using Nodejs runtime environment which will handles data queries from web servers and retrieves data from S3 by Aws Athena.This Lambda function also generates signed url for S3 export file that allow users to download the report.
- Amazon Athena
- Amazon Quicksight
- Amazon S3
- Google Map API
  - We use Google Map API to generate map and pin the accident location from queries with detail in each point.
- Amazon Code Commit
  - We've decided to use code commit to deploy code to ElasticBeanstalk from git so, we can easily manage the code version and manage deployment version and also collaborate between teammates.

- Framework
  - Nodejs
    - We use express framework of Nodejs for API part in aws Lambda function
    - We use ejs template for frontend part

Description of your data set.

We use Crashes Last Five Years dataset from Vicroads. We use Amazon S3 to store the dataset in CSV format and Amazon Athena to query the dataset. The dataset has 74,908 records of road accidents since July 2013 to Feb 2019. The dataset consists of many types of information such as road geometry, light condition, location (latitude and longitude) and severity.

Open Data Hub

Showing 1 to 10 of 74,908

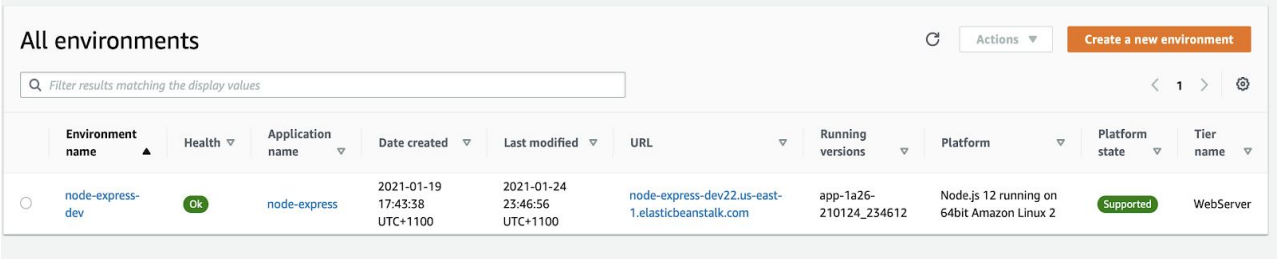
Hint: Filter columns using

ACCIDENT_NO	ABS_CODE	ACCIDENT_STATUS	ACCIDENT_DATE	ACCIDENT_TIME	ALCOHOLTIME	ACCIDENT_TYPE
T20130013732	ABS to receive accident	Finished	1/7/2013	18.30.00	Yes	Struck Pedestrian
T20130013736	ABS to receive accident	Finished	2/7/2013	16.40.00	No	Collision with vehicle
T20130013737	ABS to receive accident	Finished	2/7/2013	13.15.00	No	Collision with a fixed object
T20130013738	ABS to receive accident	Finished	2/7/2013	16.45.00	No	Collision with a fixed object
T20130013739	ABS to receive accident	Finished	2/7/2013	15.48.00	No	Collision with vehicle
T20130013740	ABS to receive accident	Finished	2/7/2013	13.40.00	No	Collision with a fixed object
T20130013742	ABS to receive accident	Finished	2/7/2013	16.10.00	No	Collision with vehicle
T20130013743	ABS to receive accident	Finished	2/7/2013	17.50.00	No	Collision with vehicle
T20130013744	ABS to receive accident	Finished	2/7/2013	17.30.00	No	Collision with vehicle
T20130013746	ABS to receive accident	Finished	2/7/2013	17.35.00	No	Collision with vehicle

Implementation

1. Setup Elastic Beanstalk Environment for web server

1.1. Setup Aws ElasticBeanstalk using a web server environment with



Nodejs 12 runtime. Aws will create an ec2 instance , load balancer , cloud watch and nginx proxy server for this environment.

1.2. Since we decided to use Codecommit for deploying the code to Elastic Beanstalk this operation will need to Install Aws cli and Elastic Beanstalk cli on local machines.

1.2.1. On root project directory init git and elastic beanstalk using command :

```
$ git init
$ eb init
```

1.2.2. Next step is to check out master branch and configure the Elastic Beanstalk environment

```
$ git checkout master
$ eb use <env name>
```

1.2.3. Add changes to git and commit change

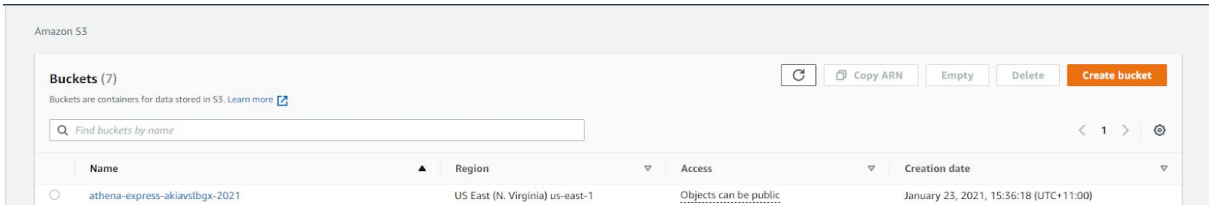
```
$ git add .
$ git commit
```

1.2.4. Deploy committed code to ElasticBeanstalk environment

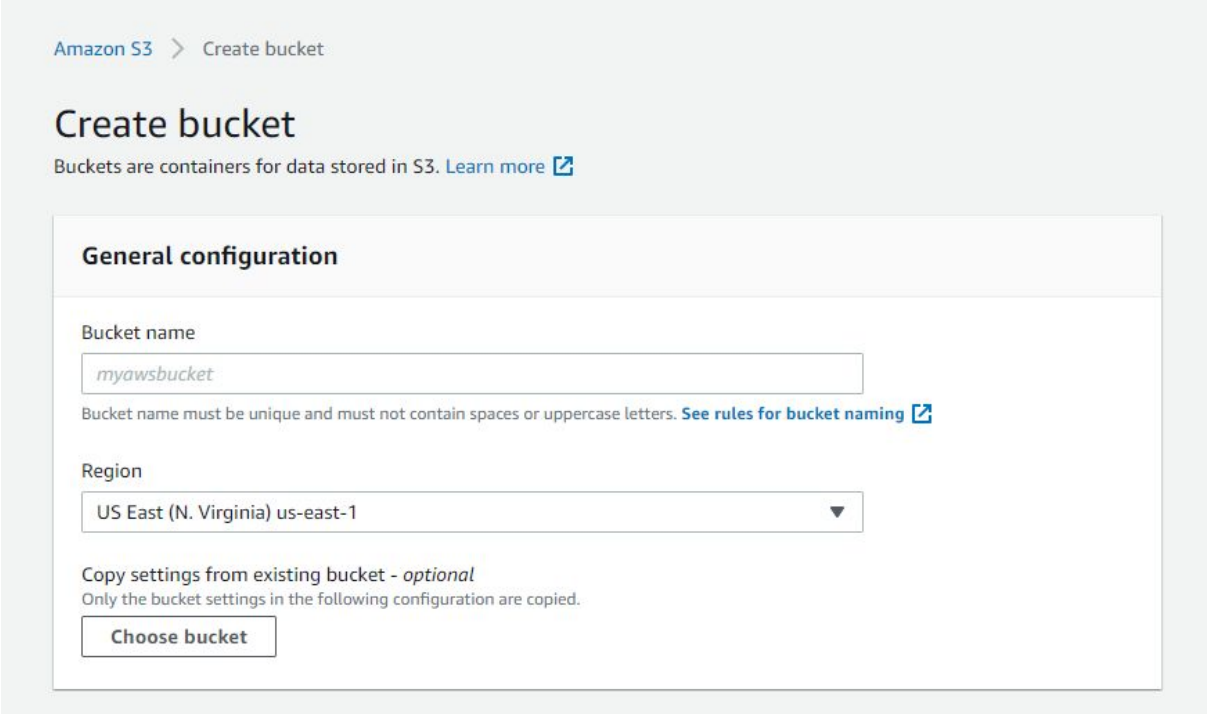
```
$ eb deploy
```

2. Create AWS S3 Bucket

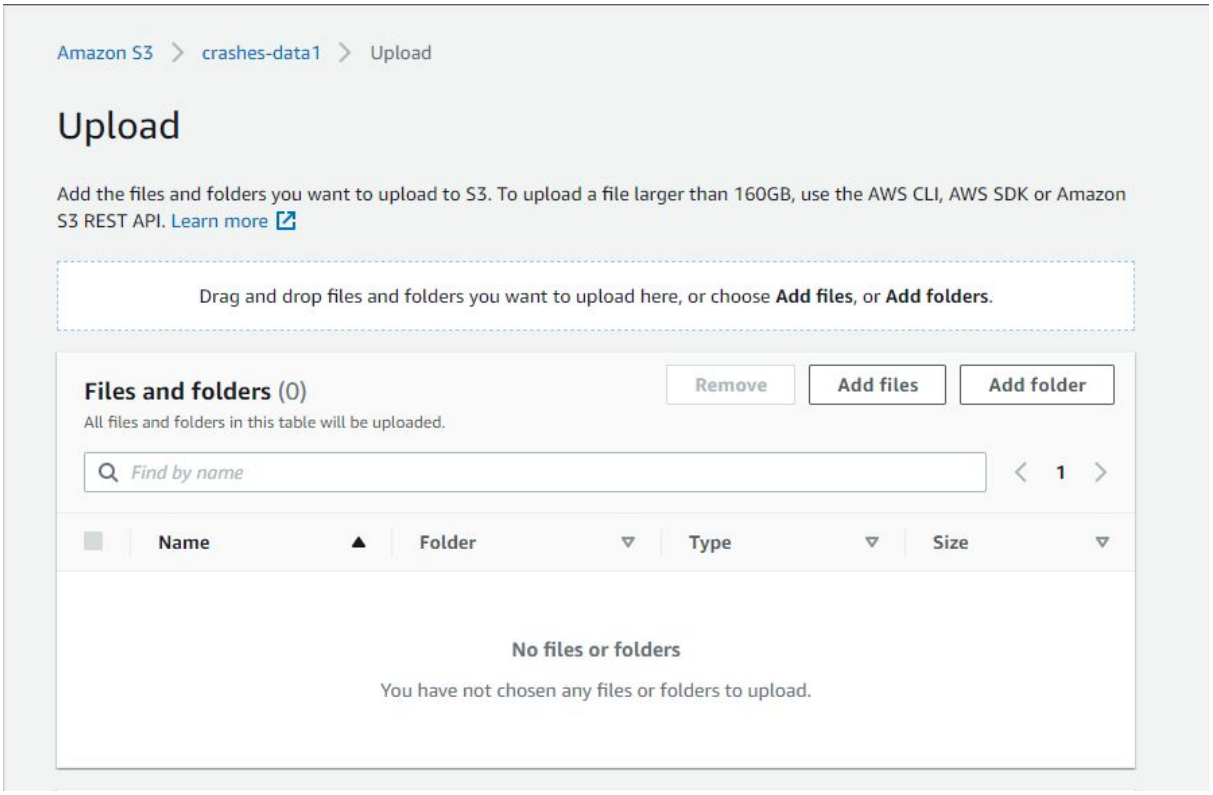
2.1. Click create bucket at Amazon s3



2.2. Name your bucket and create a bucket.

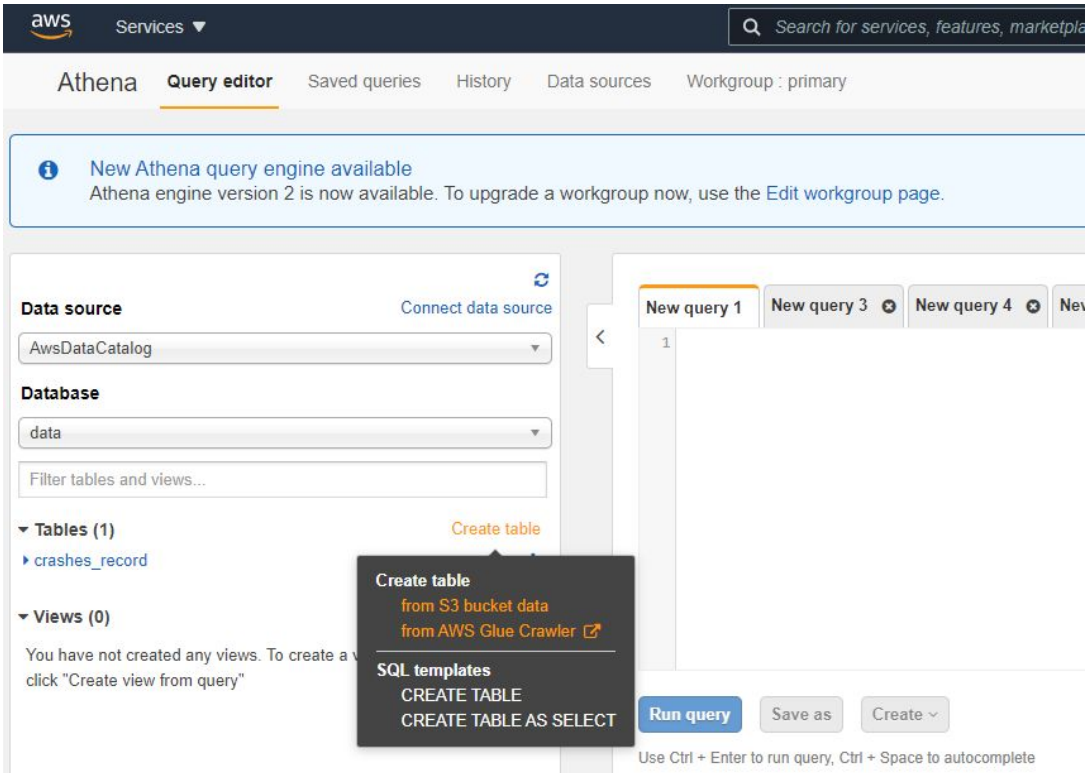


2.3. Upload CSV file to the bucket by using the Add files button.

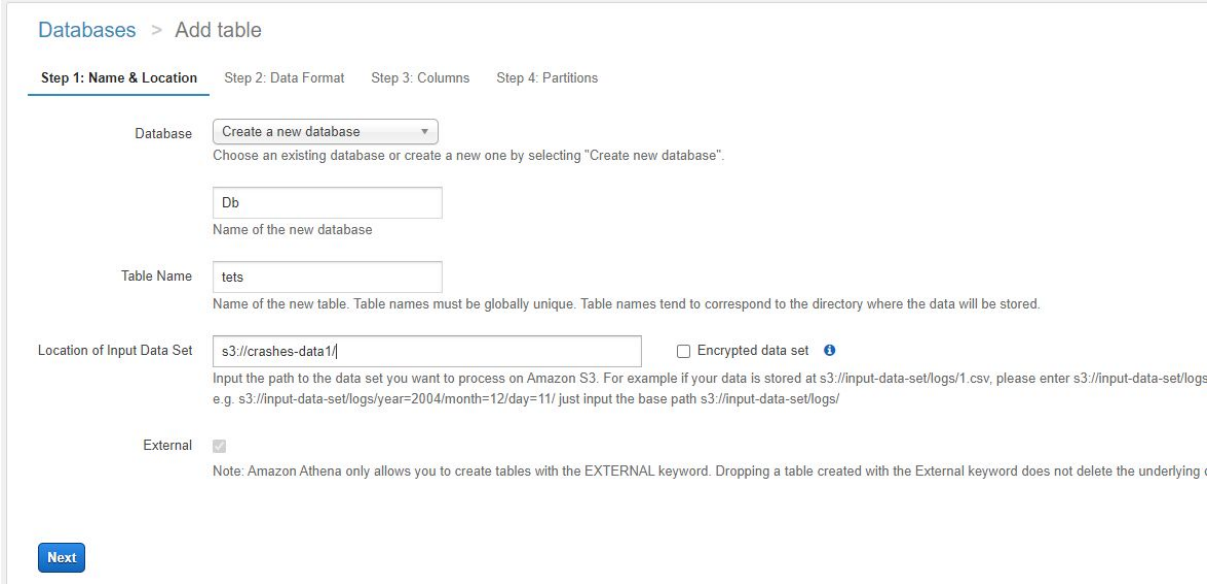


3. Create structured table in S3 Bucket using Amazon Athena

3.1. Go to Athena console and select Create table from S3 bucket data.



3.2. Add database name, table name and location of your s3 storage



3.3. Select Bulk add columns and add the following script below.

objectid int, accident_no string, abs_code string, accident_status string, accident_date string, accident_time string, alcoholtime string, accident_type string, day_of_week string, dca_code string, hit_run_flag string, light_condition string, police_attend string, road_geometry string, severity string, speed_zone string, run_offroad string, node_id int, longitude double, latitude double, node_type string, lga_name string, region_name string, vicgrid_x int, vicgrid_y int, total_persons int, inj_or_fatal int, fatality int, seriousinjury int, otherinjury int, noninjured int, males int, females int, bicyclist int, passenger int, driver int, pedestrian int, pillion int, motorist int, unknown int, ped_cyclist_5_12 int, ped_cyclist_13_18 int, old_pedestrian int, old_driver int, young_driver int, alcohol_related string, unlicencsed int, no_of_vehicles int, heavyvehicle int, passengervehicle int, motorcycle int, publicvehicle int, deg_urban_name string, deg_urban_all string, lga_name_all string, region_name_all string, srns string, srns_all string, rma string, rma_all string, divided string, divided_all string, stat_div_name string

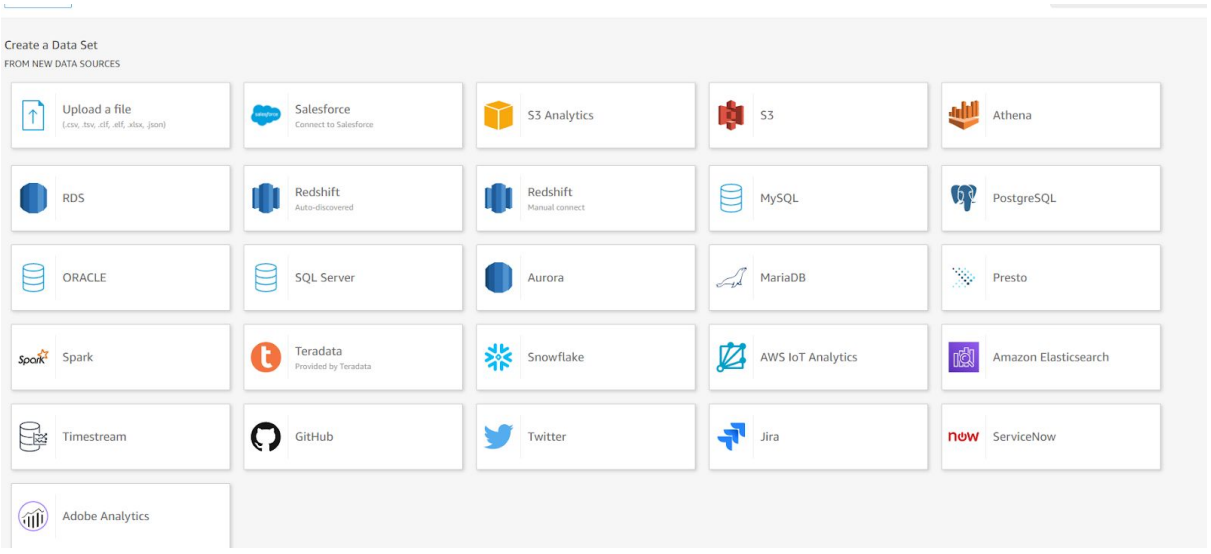
3.4. Select Create table.

4. Create Dashboard using Amazon Quicksight

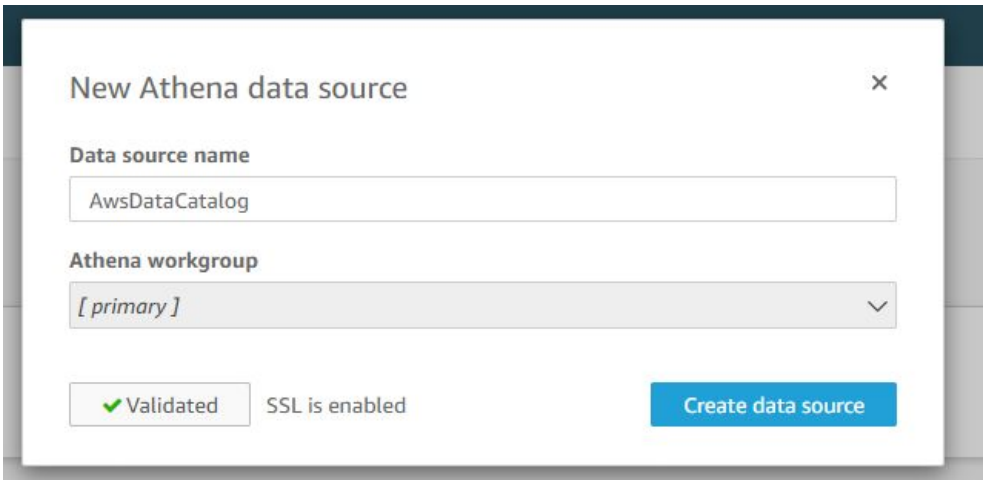
4.1. Go to aws QuickSight select Datasets on the left panel

4.2. New dataset

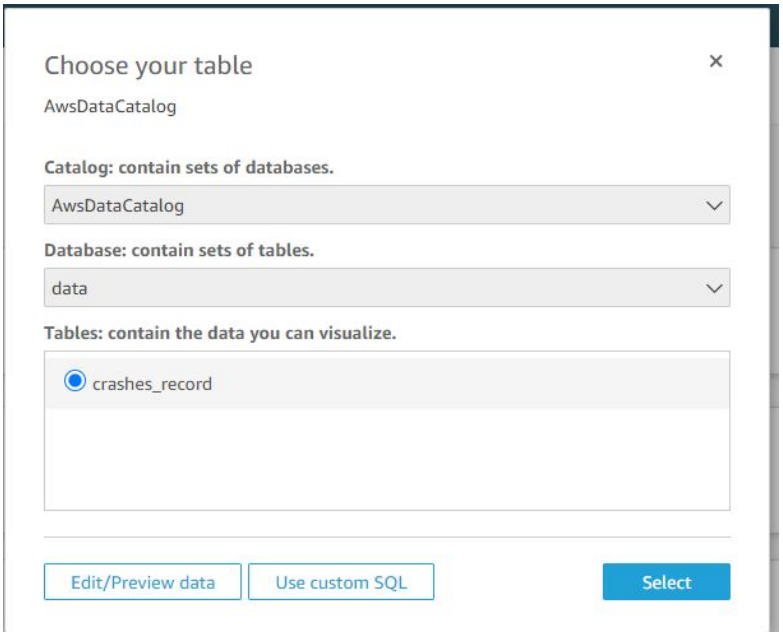
4.3. Select Athena Data source



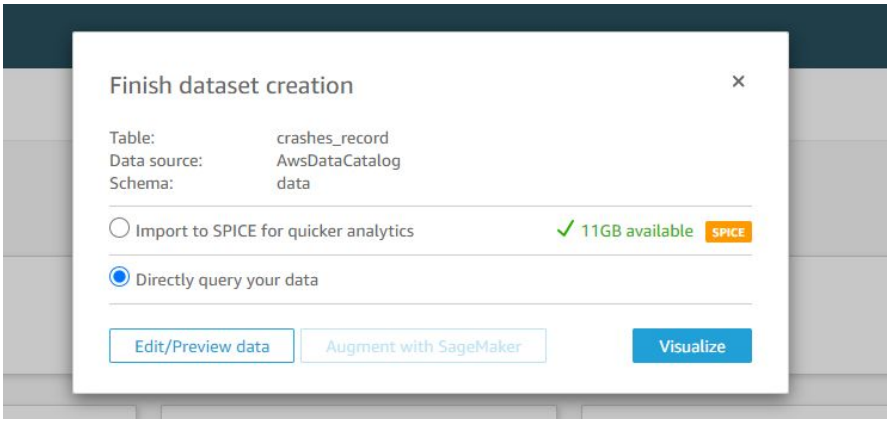
4.4. Enter your data source name and validate connection If connection has been validated create data source



4.5. Select your database and your table



4.6. Select Directly query your data and Visualize



4.7. After that create charts using tools on the left panel and create text boxes with insights function.

4.8. Share your analysis by publishing a dashboard.

5. Connect with Google Map API

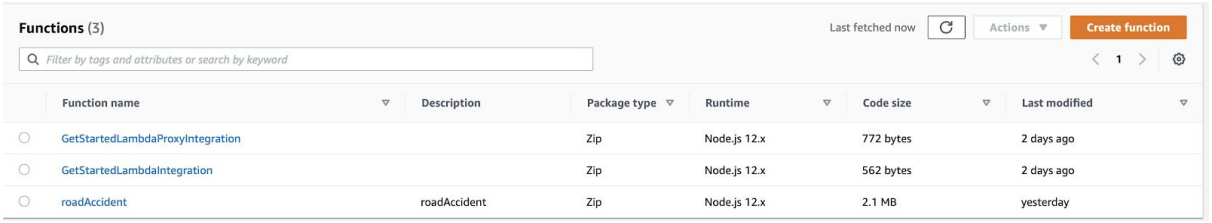
5.1. Initialize google map API using inline loading by adding inline javascript on html template this step required API key from google cloud platform.

```
<script defer
src="https://maps.googleapis.com/maps/api/js?key=
API_KEY&callback=initMap">
</script>
```

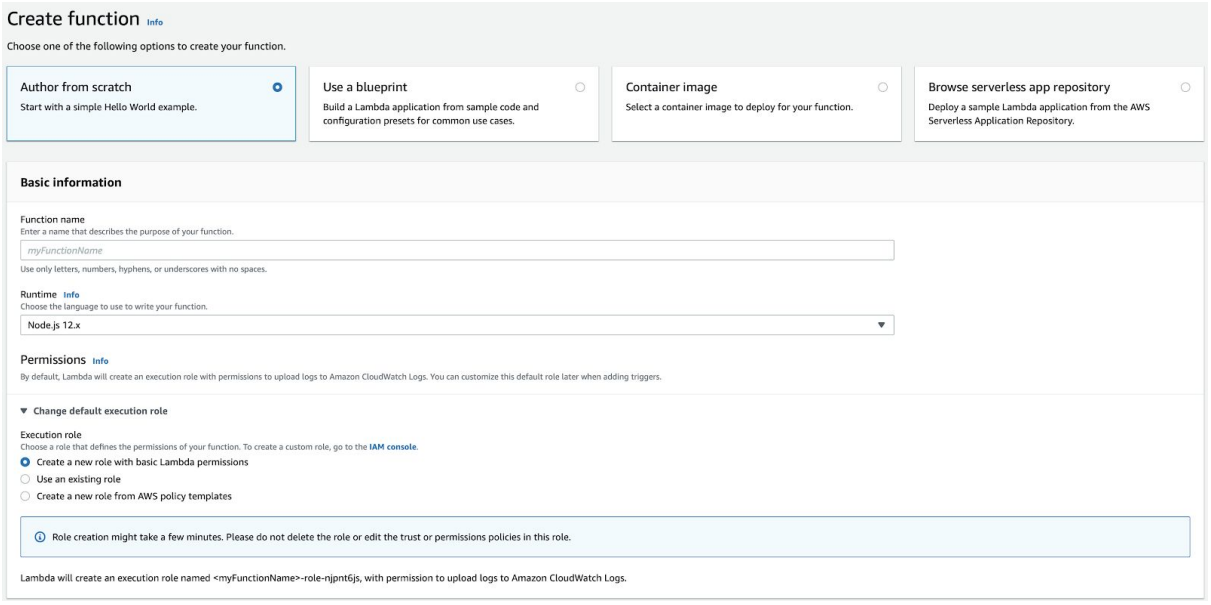
5.2. Now we can use map function in our javascript code.

6. Create Aws Lambda function

6.1. Create Aws Lambda function by aws console and click on create function button



6.2. Choose Author from scratch, fill in project name and select Nodejs runtime.

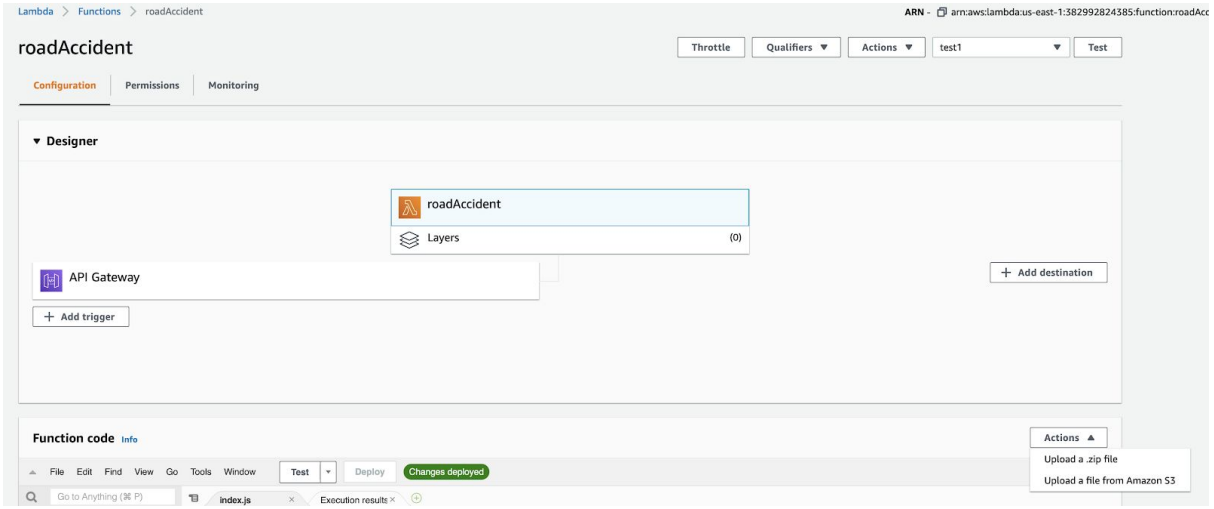


6.3. Choose create from Aws policy template to choose policies from template

6.4. Then choose simple micro service permission

6.5. After the function is created click on the function we just created

6.6. On the Function code block click on top right and select upload zip file for uploading our Nodejs project zip file.



7. Prepare Nodejs Lambda project on local machine

7.1. Create normal nodejs project which contain package.json file and index.js file

7.2. Since we going to use some dependencies such as “Athena-express” we need to install dependencies on our Nodejs project using command this step require npm installed in your local machine

$ npm install athena-express --save

7.3. The node_modules directory will be created after the command executed and the package. json file will update as follow

```
{
  "name": "lamdafunction",
  "version": "1.0.0",
  "description": "",
  "main": "index.js",
  "scripts": {
    "start": "node index.js"
  },
  "dependencies": {
    "athena-express": "^6.0.4"
  }
}
```

7.4. Add the index.js file path on tags “main” and add execute command on start tag in package.json file like in the image above.

7.5. Zip the project and upload on Aws console follow step 6.6.

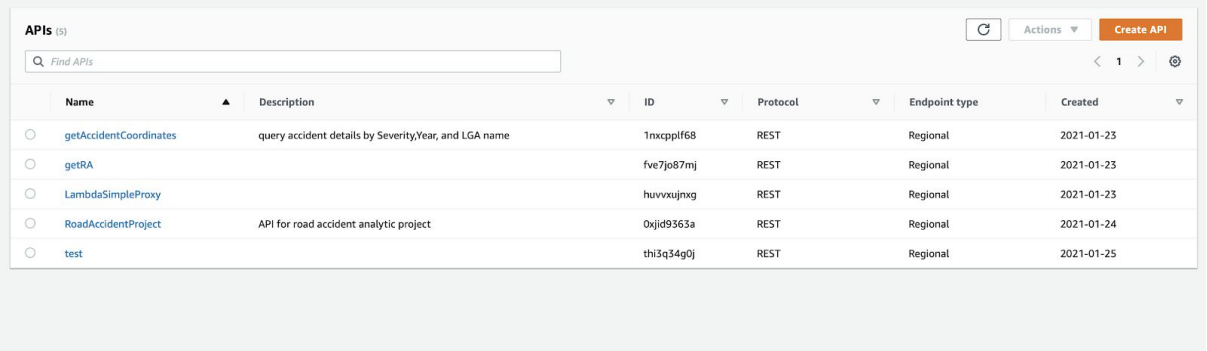
7.6. After uploading the zip file click on deploy to deploy lambda function.

8. Create API Gateway

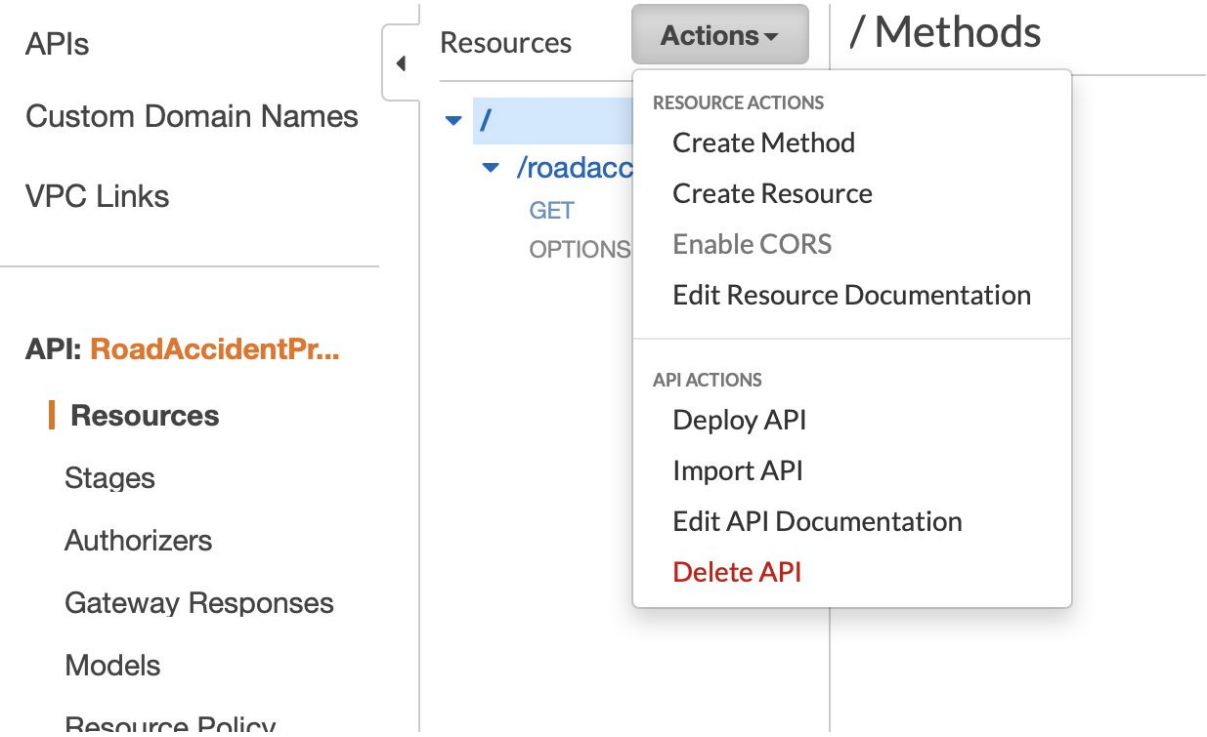
8.1. On Aws API Gateway console click on create API then choose Rest API (don’t select private)

8.2. Then fill in the API name and save

8.3. Select the new created API from the list



8.4. Click on Actions and select Create resource from the drop down list



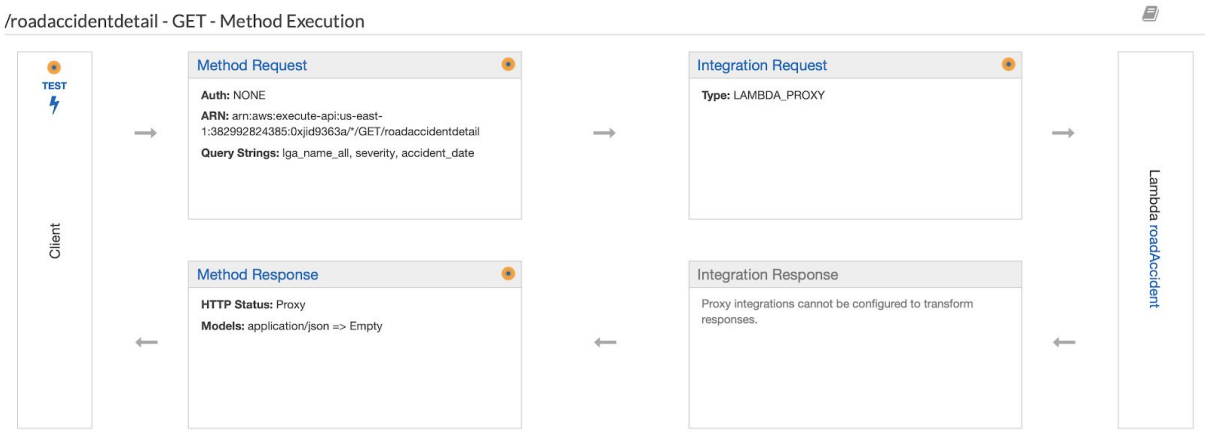
8.5. Fill in resource name and check Enable API gateway CORS

8.6. Click on the new created resource and click on actions. This time select create Method.

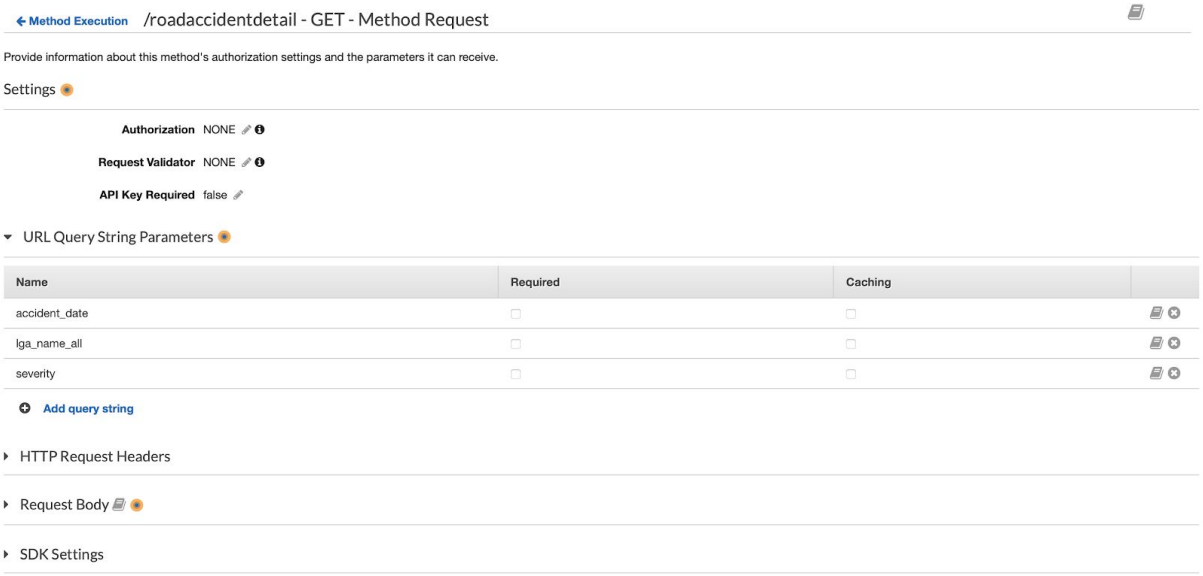
8.7. Select GET and click on the check mark.

8.8. When the setup page appear check Lambda function , type in lambda function name that we created in step 6 also check select Use Lambda proxy integration them save

8.9. Select new created method on the list then click on Method Request

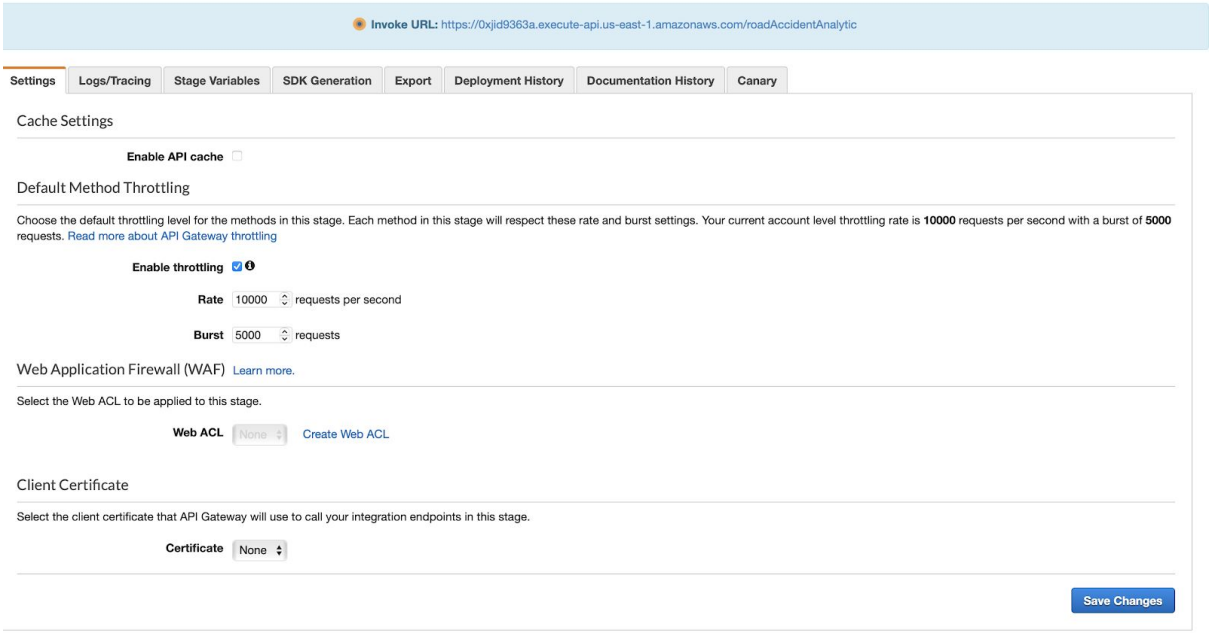


8.10. Create Query string parameters as follow



8.11. Click Action again. Now select deploy API

8.12. Use Invoke URL to call our api which is already deployed



9. Install SSL certificate on Elastic Beanstalk Load Balancer using ACM and Route53

9.1. Valid ssl certificate is required inorder to display Aws Quicksight embed dashboard correctly

9.2. Request domain name and create hosted zone

9.2.1. Registered domain using Amazon Route 53 waits until the domain has been created.

9.2.2. Create a hosted zone by putting your domain name and select public hosted zone type.

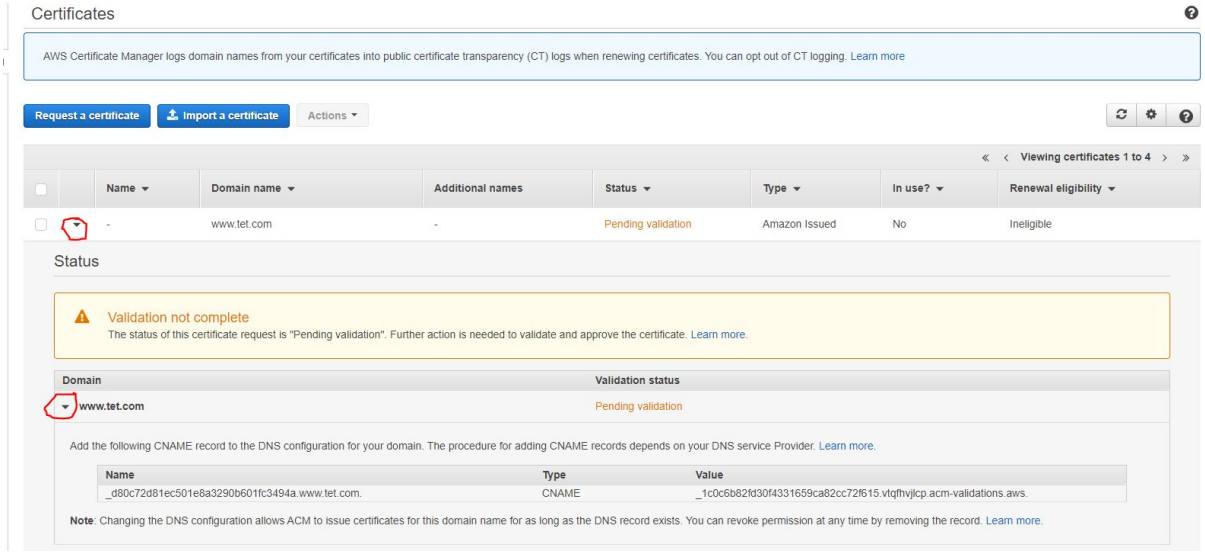
9.2.3. Go to AWS Certificate Manager and request a certificate.

9.2.4. Add your domain name in step1

9.2.5. In step 2,select DNS validation.

9.2.6. For step 3,4 and 5, use everything as default.

9.2.7. Click on the arrow in front of the Domain name. You will see the Name and Value of CNAME.

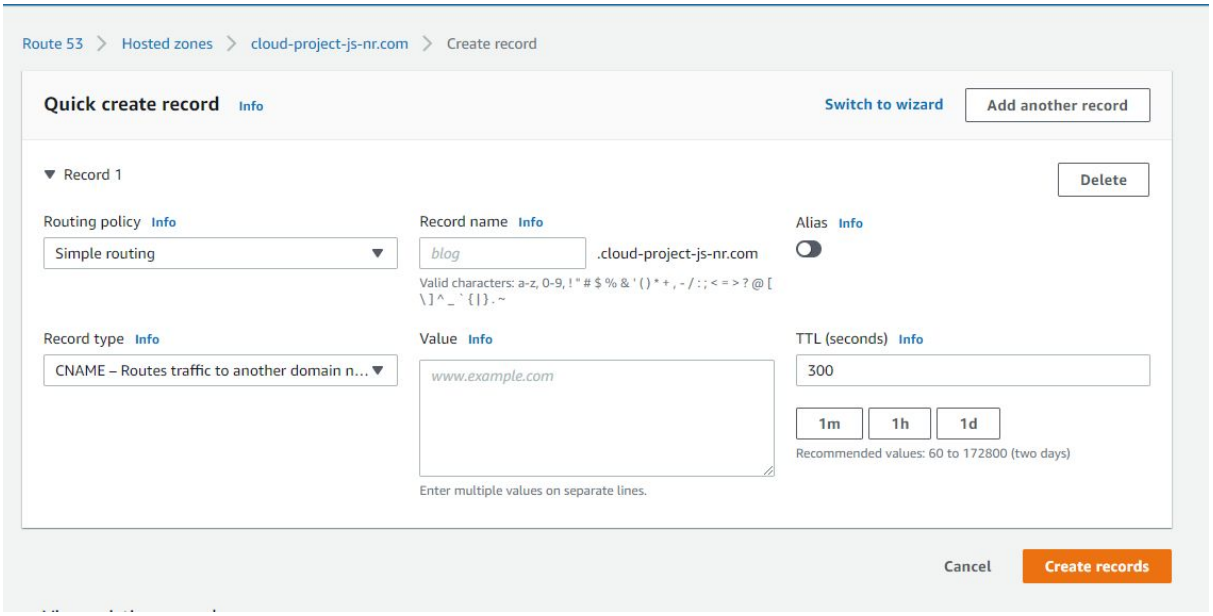


9.2.8. Go to AWS Route 53 Hosted zones.

9.2.9. Click on the domain name you want to certify.

9.2.10. Select create record.

9.2.11. Paste Name and Value of CNAME into Record name and Value. In Record type select CNAME. Then, create record

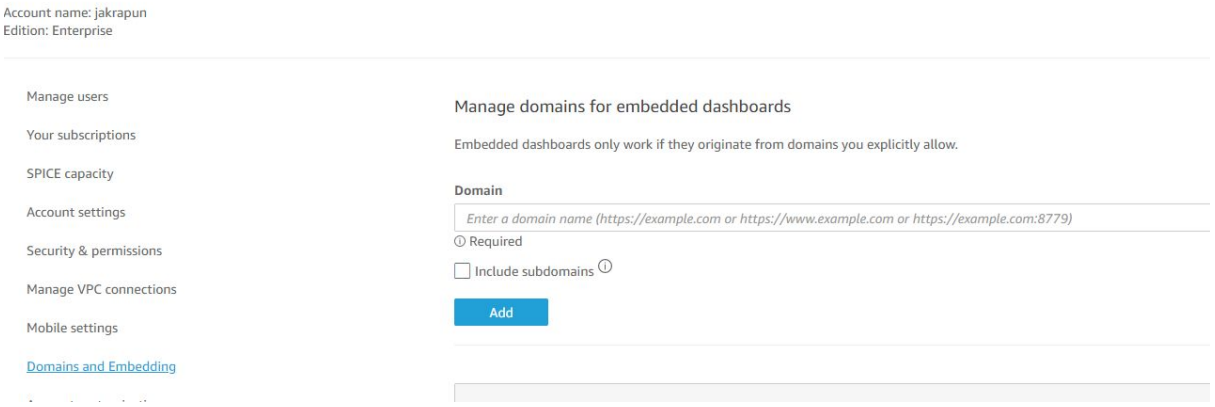


9.3. Allow QuickSight to be an embedded dashboard in your domain.

9.3.1. When your domain gets certificates go to quicksight.

9.3.2. Click on your username on top right corner and select Manage QuickSight.

9.3.3. Select Domain and Embedding and add your domain that you want to embed the dashboard and check on Include subdomains.



9.4. Request Certificate

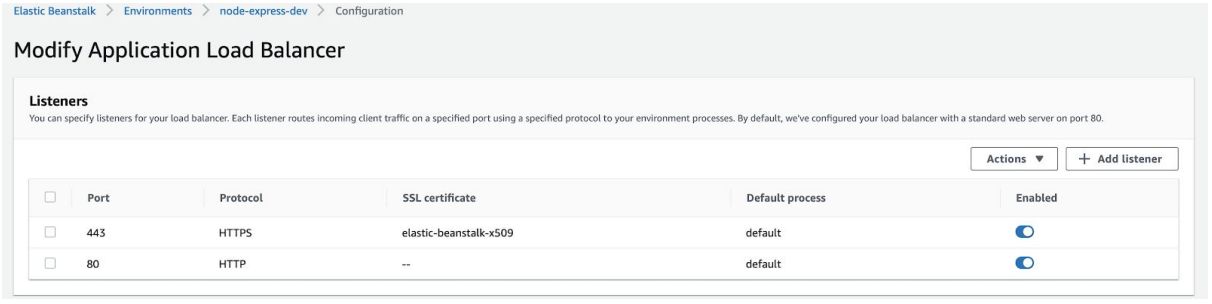
9.5. Configure Elastic Beanstalk Load Balancer

9.5.1. On Elastic Beanstalk console click on the project environment

9.5.2. Select configuration from the list

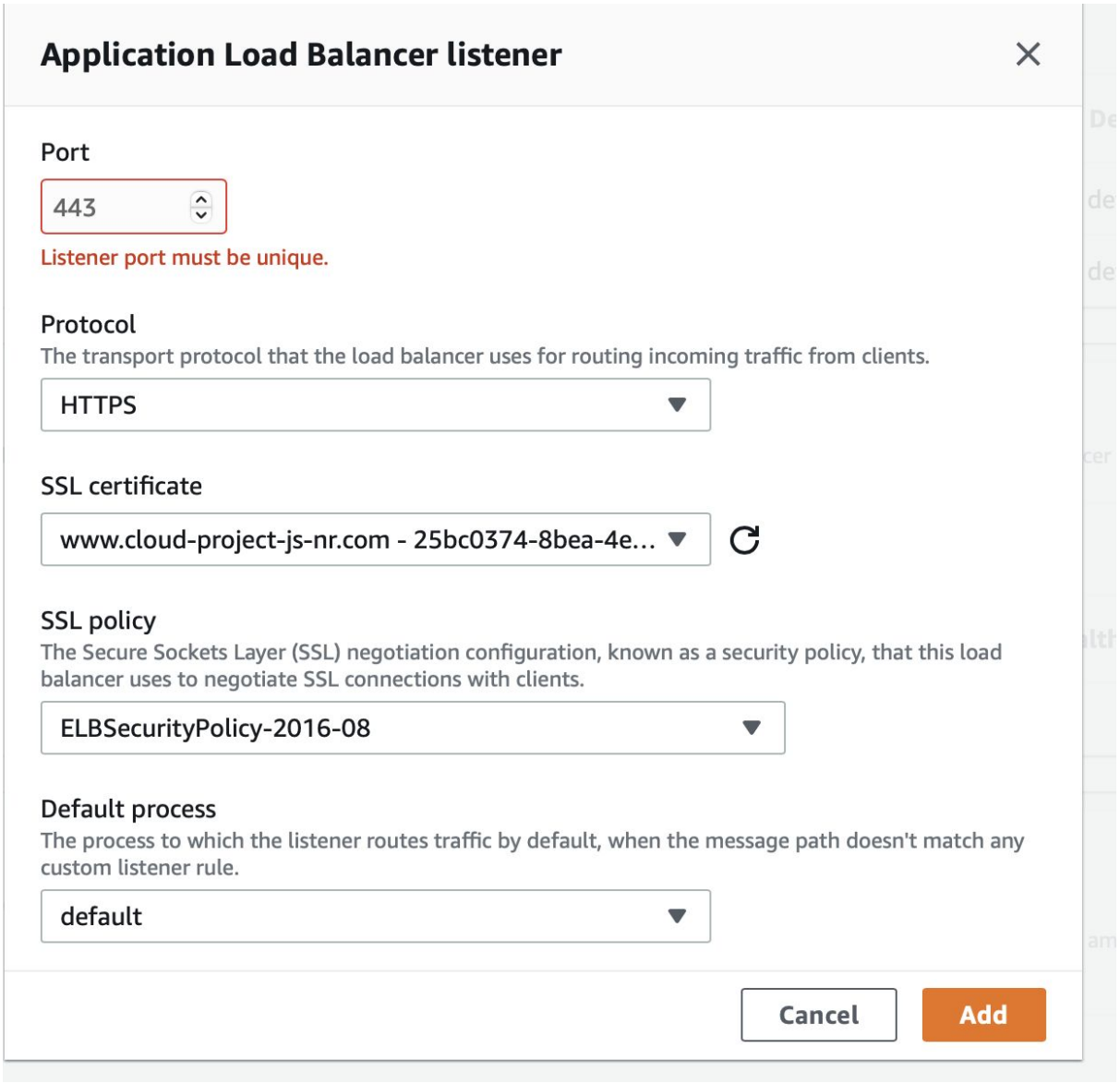
9.5.3. Click on edit button on the Load balancer block

9.5.4. On listener block click on add listener



9.5.5. In put port number 443 , select https protocol and select ssl we created from step 9.3

9.5.6. The ssl policies that Aws recommended by Aws is ELBSecurityPolicy-2016-08 so we choose that one.

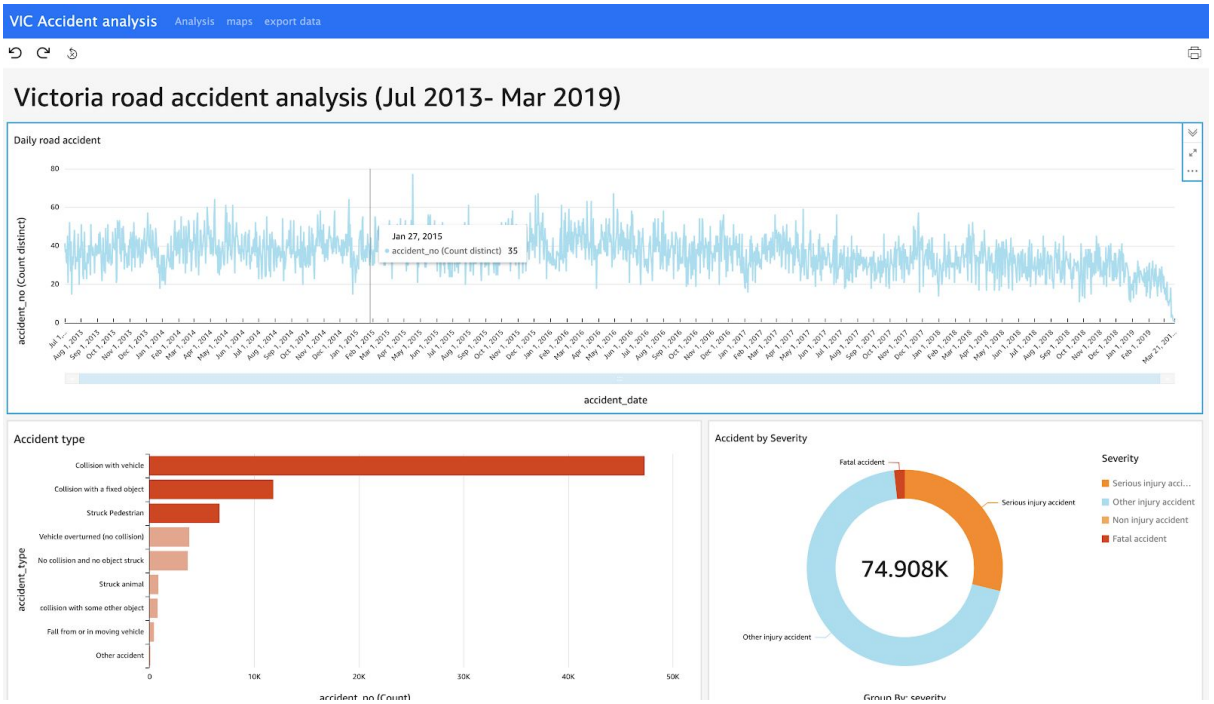


9.5.7. After click add , click apply at the end of the page. Now we can access our web application by https and Aws Quicksight embed url display correctly.

User manual

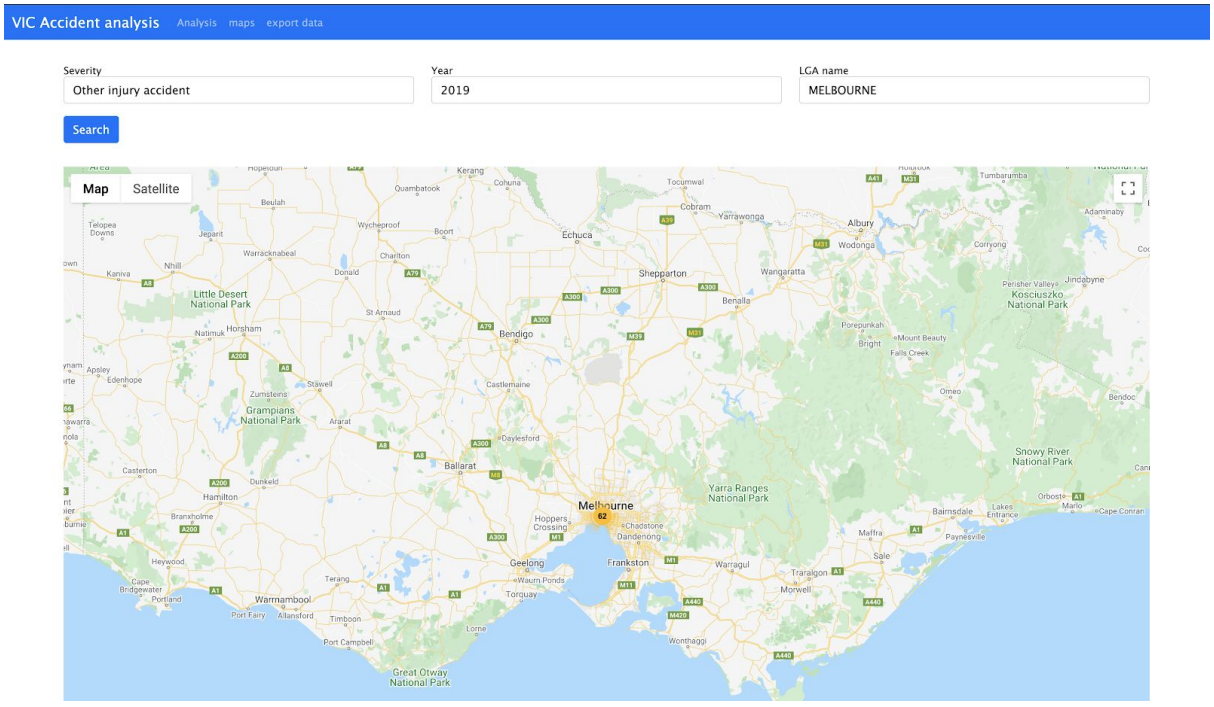
Road Accident Analysis

1. The main page will display data analysis of past 5 years road accident of Victoria

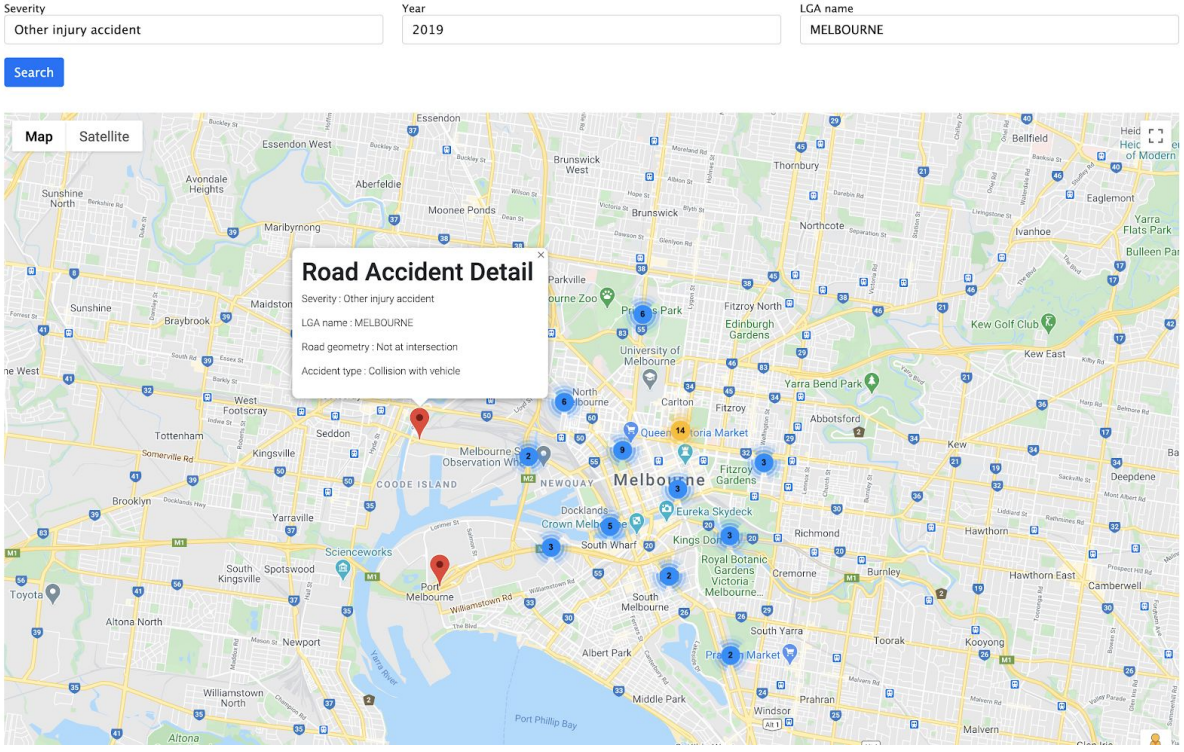


Interactive Map

1. Select map form the top navigation bar
2. The web will display interactive map as the images displayed below

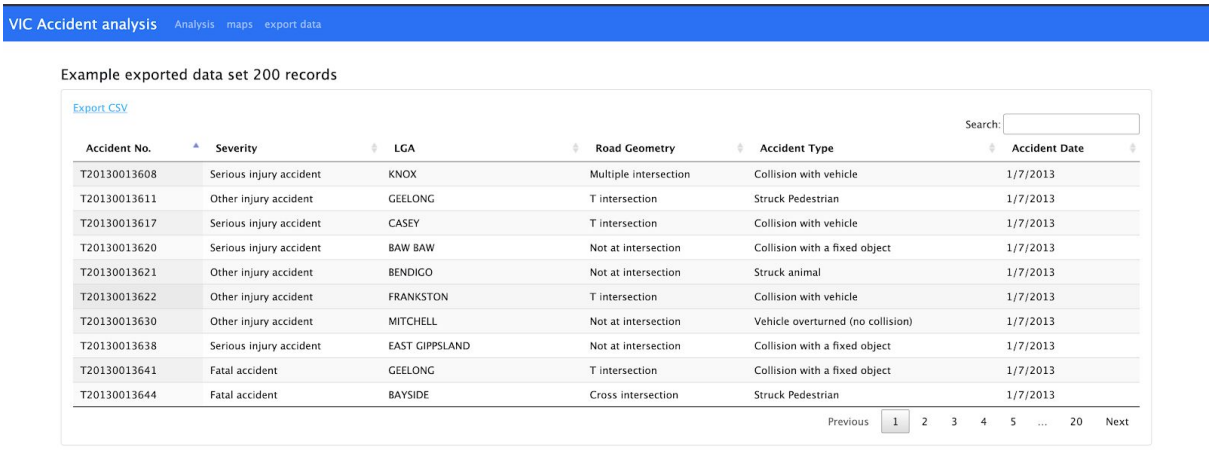


3. Select Severity, year and LGA name from dropdown list to choose to display location on the map.
4. The number show cluster of the accident location
5. Click on cluster to expand more location
6. Click on the pinned to see more detail of the accident



Export Report

1. Select export data from top navigation bar
2. The page will display table of example 200 records
3. Click on export csv link at the to of table



Reference.

[1] *Crashes Last Five Years*, Victorian Department of Transport Open Data, 2019.[Online] Available: https://vicroadsopendata-vicroadsmaps.opendata.arcgis.com/datasets/c2a69622ebad42e7baaa8167daa72127_0/data

[2] Spatial Vision, “Victorian Crash Statistics”, spatialvision.com.au. https://www.spatialvision.com.au/crashstats/ (accessed Jan. 30, 2021).

[3]ArcGIS, “My Map”, arcgis.com https://www.arcgis.com/home/webmap/viewer.html?panel=gallery&suggestField=true&url=https%3A%2F%2Fservices2.arcgis.com%2F18ajPSI0b3ppsmMt%2Farcgis%2Frest%2Fservices%2FCrashes_Last_Five_Years%2FFeatureServer%2F0 (accessed Jan. 30, 2021).